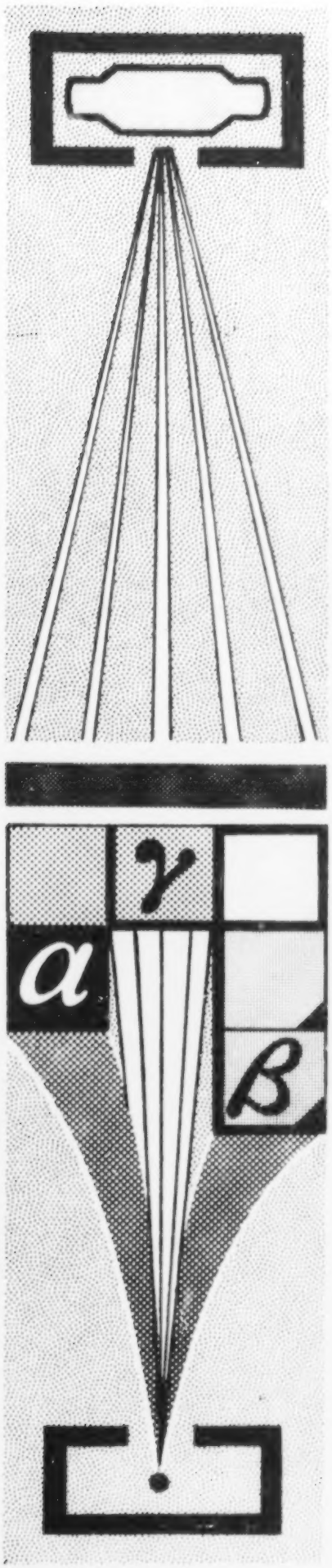

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PRELIMINARY RESULTS of 5263 X-RAY PROTECTION SURVEYS of FACILITIES with MEDICAL X-RAY EQUIPMENT...(1962-1967)

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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35

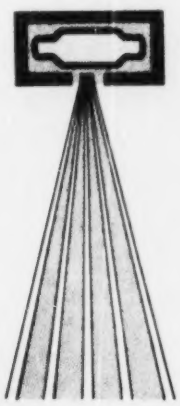
MORP 68-6

PRELIMINARY RESULTS of 5263 X-RAY PROTECTION SURVEYS of FACILITIES with MEDICAL X-RAY EQUIPMENT...(1962-1967)

by

Lawrence R. Fess, D.M.D., Dr.P.H. and LaVert C. Seabron, M.S.

X-ray Section
Medical and Occupational Radiation Program



APRIL 1968

REVISED SEPTEMBER 1968

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Control Administration
National Center for Radiological Health
Rockville, Maryland 20852

MEDICAL AND OCCUPATIONAL RADIATION PROGRAM

Technical Reports

The following technical reports issued by the Medical and Occupational Radiation Program are available through the Office of Information, National Center for Radiological Health, Public Health Service, U.S. Department of Health, Education, and Welfare, Rockville, Maryland 20852:

PHS No. 1559	Physical Survey Manual Dental X-ray
PHS No. 1582	Radiation Protection Survey Report Manual
PHS No. 1633	KWIC Index to the Journal of the Health Physics Society (1958-1966)
PHS No. 1698	Radium and the Physician
PHS No. 1831	KWIC Index to the Journal of Nuclear Medicine (1960-1967)
PHS No. 999-RH-29	Tritium Contamination in Particle Accelerator Operation
PHS No. 999-RH-30	Reduction of Radiation Exposure in Nuclear Medicine
MORP 67-1	X-ray Emission from Shunt Regulator Tubes for Color Television Receivers
MORP 67-2	Radium Disposal Project
MORP 67-3	Radium Source Integrity Testing Progress Report
MORP 67-4	Design of Interlocked Radium Shipping Container
MORP 67-5	A Summary Report on X-ray Diffraction Equipment
MORP 67-6	Georgia Radium Management Project. . . Phase II
MORP 67-7	Decontamination Study of a Family Dwelling Formerly Used for Radium Processing (Preliminary Copy)
MORP 68-1	A Collection of Radium Leak Test Articles
MORP 68-2	Recommendations for the Safe Operation of Particle Accelerators
MORP 68-3	A System for the Registration of Radiation Sources
MORP 68-4	Medical Surpak Summary Report
MORP 68-5	The Use of Radium in Consumer Products (In preparation)
MORP 68-6	Preliminary Results of 5263 X-ray Protection Surveys of Facilities with Medical X-ray Equipment (1962-1967)
MORP 68-7	A Review and Analysis of Radium Incidents
MORP 68-8	Dental X-ray Teaching and Training Replica
MORP 68-9	Development and Evaluation of an Automatic Collimator for Medical Diagnostic X-ray Machines
MORP 68-10	Survey of the Use of Radionuclides in Medicine: Preliminary Report

FOREWORD

The National Center for Radiological Health conducts a national program for the prevention and control of radiological hazards to public health through (1) surveillance activities, (2) research and development programs, (3) technical assistance to governmental and other organizations, (4) technical training programs, (5) development of criteria and codes, (6) administration of grants, (7) consultation on international programs, and (8) public information and education activities.

The Medical and Occupational Radiation Program is the component of the Center which deals with reduction of unnecessary radiation exposure of patients, workers, and others incidentally exposed by the use of X-rays, radioactive materials, radiopharmaceuticals, and particle accelerators.

The Center publishes its findings in Radiological Health Data and Reports (a monthly publication), the Environmental Health Series, Public Health Service numbered reports, appropriate scientific journals, and Program and Branch technical reports.

The technical reports of the Medical and Occupational Radiation Program (MORP) allow comprehensive and rapid reporting of the results of inhouse and contractor projects. The reports are distributed to State and local radiological health program personnel, Center technical staff, Center advisory committee members, University radiation safety officers, libraries and information services, industry, hospitals, laboratories, schools, the press, and other interested individuals. These reports are included in the collections of the Library of Congress and the Clearinghouse for Federal Scientific and Technical Information.

I encourage the readers of these reports to inform the Center of any omissions or errors. Your additional comments or requests for further information are also solicited.

James G. Terrill, Jr.
Center Director

PREFACE

This preliminary report attempts to provide a systematic analysis of the results of 5263 medical X-ray protection surveys conducted in 25 States and two territories. The sample is nonweighted; thus, data are not necessarily representative of the United States as a whole. However, the present study covers a wider geographic area than any published report on this subject. Survey results, presented in 17 tables, indicate varying degrees of compliance with the appropriate recommendations of the National Council on Radiation Protection and Measurements.

The final report of the surveys will supplement the results herein with the data from an additional 5000 surveys. At that time, data will be reported by year, to show trends in time.

The information contained in this and the later report should assist State and Federal personnel responsible for program planning by highlighting possible problem areas.

John C. Villforth
Chief, Medical and Occupational
Radiation Program

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INTRODUCTION

As of June 30, 1967, the data from 5263 X-ray protection surveys of facilities with medical X-ray equipment were available from retrieval from magnetic tape records. These 5263 surveys had been sent to the National Center for Radiological Health from 25 States and two territories and cover the period 1962 through 1967. The survey data was collected on standardized forms supplied by the Public Health Service. From this data frequency distributions were produced on selected items of interest and will serve as a foundation for selecting and developing intervals for tables of interrelated items. The report that follows summarizes the information available in the frequency distributions. It must be pointed out that the primary purpose of this report is to permit a comparison between those healing art specialties which provided the largest homogeneous mutually exclusive subsamples. Note that the "total" column is not the sum of the numbers given for the specialties under type of facility or type of practice. The reason for this is that there were many categories which provided too small a subsample to permit comparison with the larger groups appearing in the tables, but which were still part of the greater picture of facilities or practices with medical X-ray equipment.

There are in many tables a large percentage of "unknown" which is partially explained by the fact that some participating States do not require these particular items of information to be collected as part of their X-ray survey program.

The card information referred to in the tables pertains to the facility form, radiographic form, and fluoroscopic form information described in the Radiation Protection Survey Report Manual published by the National Center for Radiological Health (1). For each form used in a survey of an installation or facility, there is a corresponding IBM card, hence, the term facility card (form) information, or radiographic card (form) information.

This report attempts to provide a systematic approach to the analysis of the data. Throughout the report reference is made to NBS Handbook 76 (2), which has been superseded in part by NCRP Report No. 33 (3). The reader is reminded that during the time these data were collected the performance and design recommendations then in effect were those described in NBS Handbook 76. The first section of this report provides a profile of the "average" medical diagnostic X-ray facility as obtained from this particular sample. Bear in mind that none of the averages or ratios in the "total" column is in any way typical of the specialties except by chance. The second section highlights by type of facility or type of practice those specific items which seem to indicate either conformance with or deviation from accepted practice.

A PROFILE OF THE "AVERAGE" MEDICAL DIAGNOSTIC X-RAY FACILITY

The first section of this report is an attempt to provide a profile of the "average" medical diagnostic X-ray facility of this sample. It is realized that there can be no such thing as an "average" facility, and needless to say there are no fractions of persons or X-ray machines or of X-ray tubes in operative condition. The reader is further cautioned to look to the tables to see the ranges in averages or the ranges which are summarized in this "average" facility. Rather than clutter this view of the sample with details of distributions, the authors have attempted to provide a summary of data in this preliminary report, saving details for subsequent papers which will report by fiscal year and by type of specialty. With this in mind the data from this sample of 5263 facilities with medical X-ray equipment provides the following characteristics for the "average" X-ray facility:

There are per facility 2.5 persons occupationally exposed; 2.1 persons who are X-ray machine operators, who may or may not have had formal training in radiologic technology; and 1 person who is equipped with a personnel monitoring device.

Per facility there are 1.36 X-ray machines having 1.22 tubes per machine. The equipment is likely to be a permanently installed, non-mobile, radiographic machine with a 50-50 chance of having fluoroscopic as well as radiographic capabilities. The tube housing will be of diagnostic type in 87% of the cases. The machine is likely to have a maximum kilovolt peak which is between 75-149 and a maximum milliamperage between 100-399. The "average" machine in the "average" facility has on commencing inspection less than a 50% chance of meeting the NBS Handbook 76 recommendation of 2.5 millimeters of aluminum equivalent filtration. On completing the inspection this chance increased to approximately 65%. The exposure switch location is generally adequate to protect the operator from (1) the primary beam, and (2) most secondary and scatter radiation, either because of the presence of barriers or because of the distance from the source of radiation. The switch itself is of the deadman type, and timer is such that it requires manual resetting and terminates exposure after a preset time.

The workload in patients radiographed per week is 47.4; in patients fluoroscoped per week it is 11.3.

The facility is most likely to have a darkroom and is most likely to use a time-temperature relationship in the manual processing of films.

The primary and secondary barriers are such that both the operator position and the environs meet either State or NBS Handbook 76 recommendations. Special aprons or devices used to protect the gonads of the patients are not likely to be present.

The procedure comprising the major part of the workload is likely to be a chest or thoracic examination. The usual kilovolt range for the major procedure whether it be a chest examination or not is between 50 and 74 kVp. The tube current and exposure time expressed as milliampere-seconds is likely to be between 6 and 25. The film size most likely to be employed is 14-by 17-inches, and the film distance from the source of radiation will be approximately 6 feet. The shape of the beam is usually circular, and in approximately 1/3 of the cases the beam is improperly collimated in that the beam diameter exceeds the longest dimension of the film by more than 2 inches.

In regard to equipment used for fluoroscopic purposes, information was available on only 2266 machines in the sample of facilities being reported:

The fluoroscope is most likely to be a part of an X-ray machine having both fluoroscopic and radiographic capability. It is likely to be integrated into a tilting table and not equipped with an image intensifying device. The fluoroscope screen is interlocked with the X-ray tube so that they move as a single unit. It is equipped with shutters which limit the beam to the leaded glass covering the fluorescent screen in only 50% of the cases. The usual target-to-panel distance is 12 inches or greater with the Roentgen output at the panel less than 10 Roentgens per minute. Before correction there was approximately a 40% chance that the filtration was equal to or greater than 2.5 millimeters of aluminum equivalent. This was increased to approximately 48% because of the survey.

The unit is equipped with the deadman type of exposure switch, and approximately 1 in 3 will have a manually reset, cumulative timer that terminates exposure. The unit has a 67% chance of being in a light-tight room. The "average" user of the fluoroscope dark adapts approximately 16 minutes. In general, the facility with a fluoroscope will have leaded aprons. However, Bucky slot covers and leaded drapes around the screen will be present in only 50% and 30% of the units respectively.

The usual kVp for an upper gastro-intestinal examination is likely to be between 75 and 99 kVp. The "average" tube current used is between 2 and 3 milliamperes per examination. (There is no direct information on milliamperage in these tables, but it can be derived from the total milliampere-minutes per week, the number of examinations and the time in minutes per examination.) The "average" tube activation time for an examination is 3.1 minutes. There are on the "average" approximately 12 examinations per week.

The most usual kVp for lower gastro-intestinal examinations was found to be between 75 and 99 kVp. Again there is no direct information on milliamperage from this data, but again it can be derived using the total milliampere-minutes per week, the number of examinations, and the time in minutes per examination. From this calculation it can be determined that the milliamperage per an examination is between 2 and 3. The average tube activation time for an examination is 2.9 minutes.

There are approximately 8 lower gastro-intestinal examinations per week per facility. A summary of the fluoroscopic workload indicates there is a total number of 29 examinations and 76 spot films per week per facility. This results in a total of 145 milliampere-minutes of exposure per week per facility.

The above paragraphs describe the "average" facility based on the data contained in the tables of this report and apply, therefore, only to this sample.

SELECTED HIGHLIGHTS

Table 1 - Personnel, Workload, and Equipment:

The data presented by type of practice and type of facility reveal that the number of personnel (including those occupationally exposed, X-ray machine operators and those monitored), as well as the quantity of equipment is related to patient workload, and this workload is found to be greatest in hospitals, in radiologists' offices and in clinics as would be expected.

Table 2 - Darkroom Procedures:

Under the item lighttightness of darkroom, it is evident that the pediatricians and the practitioners of internal medicine exhibit the highest percentages of facilities having no darkroom. It is felt that this may be due to the high percentage possessing fluoroscopes that are not part of a combination unit having both radiographic and fluoroscopic capabilities. The data indicate that automatic film processing units are most likely to be found in those facilities having the largest workloads (radiologists' offices and hospitals).

Table 3 - Equipment Identification:

The variations noted in the maximum kilovoltage and maximum milliamperage are as would be expected. The category "unknown" maximum kilovoltage has several percentages that are between 10 and 18. These and probably most of the category of unknown may be conceivably due to older equipment. When looking at this same category for maximum milliamperage, it can be seen that the percentages are generally lower. This would not seem unreasonable since milliamperage is more likely to be known on the same older equipment for which the kilovoltage is not known.

Table 4 - Filtration:

The increase in units having 2.5 millimeters or more of aluminum filtration as evident from the change in percentages before survey to those after survey reflect in part the efforts of the National Center for Radiological Health in this area through their program of supplying filters to the States. In subsequent reports, the data on filtration will be related directly to the kVp of the machine so that the evaluation of filtration adequacy will be more meaningful.

Table 5 - Exposure Switch, Timer, and Protective Devices:

Gonadal shields for patients do not appear to be in widespread use. They are present more frequently in those types of facilities and practices where the workload is greatest. Although 65% of the radiology offices

reported having gonadal shields, only 33% of the general practitioners in private practice so reported.

Table 6 - Procedures and Related Factors Reported as Comprising the Major Part of the Workload:

A high percentage of most specialties report chest examination as their major procedure. However, there are as many orthopedists reporting extremity procedures as there are reporting chest examinations. Two-thirds of the chiropractors report procedures on the spine as their major area of interest. This information is not unexpected.

It appears that in a majority of the examinations most frequently reported, a circular X-ray beam is used with a 14- by 17-inch film. The beam size associated with 32% of these examinations is equal to or greater than 25 inches. In as much as the longest diagonal of the 14- by 17-inch film is only 22 inches, the data would indicate that none of the facilities is totally free of some problem in proper collimation according to film size. Note that for hospitals and for radiologists' offices excessive beam size is reported for 21% and 25% of the facilities respectively. This would indicate that in a number of facilities the reduction of improper collimation still remains as an area of needed emphasis. The data would appear to indicate a relationship between proper collimation and the use of a variable collimator. In most instances where there is a low percentage of machines reported as having variable collimation, there is a high percentage of improper collimation (exception - chiropractors). The reverse is also true. A high percentage figure reported for variable collimation is associated with a low percentage for improper collimation.

Table 7 - Fluoroscopic Equipment Identification:

Over 50% of the X-ray machines in the possession of practitioners of internal medicine have fluoroscopic capability only, and over 60% of the X-ray machines with fluoroscopic capability are of the vertical type. The data also indicate that a large percentage of X-ray machines possessed by the pediatricians in this study have fluoroscopic capability only. If equal or better information of a permanent nature could be obtained from a radiograph, this would result in a much lower patient exposure. It might be well to note that nearly half of all X-ray machines with fluoroscopic capability are in hospitals or in radiologists' offices. Whereas image intensifying devices which result in a much lower patient exposure are in use primarily in hospitals and in radiologists' offices, still only 15% or so of these facilities possess these devices.

Table 8 - Fluoroscopic Screens:

Fluoroscopic screens are not interlocked with the X-ray tube in approximately 15% of the facilities of pediatricians, orthopedists and chiropractors. This may be a dangerous situation resulting in an unusually high exposure to the operator.

There is no immediate explanation for the high percentages of leaded screens of undetermined adequacy in the case of general practitioners in private offices and clinics.

The relation of the fairly high percentage of cases (40%) in which the useful beam is not limited to the fluoroscopic screen, as compared to low percentage of cases (8%) of improperly functioning shutters, may be explained in part by the failure of the surveyor to evaluate shutter function and beam limitation at the maximum screen-to-target distance. A properly functioning shutter is one that restricts the useful beam to the area of the fluorescent screen at any target-to-screen distance. This is indicated by an unilluminated area on all four sides of the fluorescent screen.

Table 9 - Target-to-Panel Distance, Roentgen Output at the Panel Surface, Lighttightness of Fluoroscopic Room:

In general the target-to-panel distance complies with the recommendation in NBS Handbook 76 and NCRP Report #33. The target-to-panel distance is at least 12 inches in approximately 86% of the facilities. Approximately 9% of the fluoroscopes in osteopathic facilities and in the private offices of general practitioners are operated at less than a 12-inch target-to-panel distance. This may account for the high percentage of facilities with Roentgen output at the panel surface in excess of 10 Roentgens per minute in these two specialties. It is interesting to note the high percentage of facilities reporting less than 10 Roentgens per minute. This would tend to indicate that the 10 Roentgens per minute limit as specified in NBS Handbook 76 could be reduced. Along these lines the State of New Jersey restricts the output at the panel surface to 5 Roentgens or less[1] and has had no difficulty in attaining compliance. Interestingly enough those types ot facilities reporting less than 1 Roentgen per minute are those same types reportedly using image intensifying devices. In future reports an attempt will be made to express Roentgen output at the panel surface in terms of Roentgens per milliampere-minute as prescribed in NCRP Report #33.

In regard to the lighttightness of the fluoroscopic room, those types of facilities reporting this item as "not applicable" are those same facility types reporting the use of image intensifying devices. This is as would be expected since these devices do not require total darkness for efficient use as does conventional fluoroscopy.

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[1] State of New Jersey. Radiation Protection Code. Chapter 2, Section 18.2.1.11. (January 1965).

Table 10 - Fluoroscopic Filtration:

The high percentages of "unknown" for this item for all facility types is due to the difficulty the surveyor encounters in trying to actually measure the filter thickness. Since this would in most instances necessitate the partial dismantling of the fluoroscopic table, the surveyor tends to report this item as "unknown." This would indicate a need for further training of surveyors in methods of determining filtration of fluoroscopes by indirect means such as half value layer determination. It is reasonable to assume that many of these "unknown" would fall into the category of 2.5 (or more) millimeters of aluminum equivalent thereby increasing the percent in compliance with recommendations of NBS Handbook 76.

Table 11 - Timer Information:

The percentage of facilities reporting fluoroscopes that are not equipped with manually reset cumulative timers is high where one might expect to find older equipment, and low where one might expect newer equipment. It might very well indicate the general age of the equipment. Since this timer can be an expensive addition to old equipment, many owners would naturally be reluctant to add this feature voluntarily and would probably not do so without a vigorous follow-up program in the State.

Table 12 - Dark Adaptation:

Osteopaths and pediatricians, in particular, appear to dark adapt considerably less than the average of 16 minutes indicated in this sample. It might be conjectured that this could be associated with increased patient exposure if dark adaptation is really insufficient and milliamperage is put at a setting higher than would be necessary if proper dark adaptation were followed.

Table 13 - Accessory Shielding:

The absence of Bucky slot covers and leaded drapes around the screen is a further indication of the age of the equipment. In those facilities where the equipment is likely to be new or of recent vintage these accessory appurtenances are more likely to be present. Where the opposite is the case these are not likely to be installed without a vigorous follow-up effort on the part of the State. The data tend to support this thesis.

Table 14 - Upper Gastro-intestinal Examination:

It would appear that upper gastro-intestinal examinations are performed chiefly in radiologists' offices and in hospitals. The high percentages in the "unknown" category reported for internal medicine facilities and for general practitioners may well be due to the fact that these procedures are rarely if ever done by these specialties, and that to signify this, the coding for "unknown" rather than "not performed" was used.

The duration of tube activation per examination does not vary appreciably from the average of 3.1 minutes.

As would be expected and is probably desirable, the greater workloads are associated with hospitals and radiologists' offices.

Table 15 - Lower Gastro-intestinal Examination:

It would appear that lower gastro-intestinal examinations are also performed chiefly in radiologists' offices and in hospitals. Again the high percentages in the "unknown" category for internal medicine facilities and for general practitioners are most likely due to a similar coding error as cited above in the case of upper gastro-intestinal examinations.

The duration of tube activation per examination does not vary appreciably from the average of 2.9 minutes.

Again the greater workloads are associated with hospitals and radiologists' offices.

Table 16 - Spot Films and Fluoroscopic Examinations other than Gastro-intestinal:

It would appear from these data that all other fluoroscopic examinations combined do not equal the number involving the gastro-intestinal region.

The distribution of the number of spot films which may be a part of any fluoroscopic examination is in accord with the fluoroscopic patient workload. This is evidenced by the fact that the average number of spot films for radiologists' offices, hospitals, and multiple specialty clinics are respectively 111, 81, and 64. These types of facilities have the higher patient workload.

Table 17 - Total Milliampere-minutes Workload:

The greatest part of the fluoroscopic workload is handled in radiologists' offices and in hospitals as might be expected and which is desirable.

CONCLUSIONS

The data indicate the following areas in which major efforts should be made:

1. Equipment

The high percentages of facilities having improper collimation, inadequate filtration, lack of accessory shielding and absence of manually reset cumulative timers on fluoroscopes indicate that a major effort in the correction of equipment is still needed. This effort, if applied, would help in the reduction of unnecessary population and occupational exposure.

2. Standardization of Survey Techniques and Data Collection

The high percentages of "unknowns" in this data emphasize the need for the standardization of surveying techniques and for promotion of uniformity and comparability of data collected in State radiological health programs. Survey forms should also be revised using NCRP Report #33 as a guide, and all data inquiries should be eliminated that are meaningless, doubtful, or of little value in defining or assessing radiological health problems and progress.

3. Technique and Judgment

A continuing effort aimed at improving the technique of the operator of the machine and the professional judgment of the physician requesting the examination is essential if the efforts toward dose reduction are to be successful. The use of fluoroscopy in those cases where a radiograph would serve a far more useful purpose and inadequate beam collimation in facilities where adequate collimating devices are available reinforce this conclusion.

REFERENCES

(1) U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PUBLIC HEALTH SERVICE, NATIONAL CENTER FOR RADIOLOGICAL HEALTH. Radiation Protection Survey Report Manual. Public Health Service Publication No. 1582. (January 1967).

(2) U. S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS. Medical X-ray Protection up to Three Million Volts, National Bureau of Standards Handbook 76. Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. (February 1961).

(3) NATIONAL COUNCIL ON RADIATION PROTECTION AND MEASUREMENTS. Medical X-ray and Gamma-Ray Protection for Energies up to 10 MeV, Equipment Design and Use, NCRP Report No. 33. NCRP Publications, Washington, D. C. 20008. (February 1968).

TABLE 1. FACILITY CARD INFORMATION (PERSONNEL, WORKLOAD AND EQUIPMENT) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Facility card information Personnel Workload Equipment	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private offices	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinics	Hospitals	Chiropractors	Total*
Number of facilities	146	280	65	1508	122	134	200	141	740	904	5263
Personnel											
Average no. of personnel occupationally exposed	4.3	2.4	2.0	2.1	2.5	1.6	3.4	3.7	5.0	1.2	2.5
Average no. of X-ray machine operators	3.7	1.9	1.7	1.8	1.8	1.5	2.6	2.8	4.2	1.1	2.1
Average no. of personnel monitored	3.2	0.5	0.1	0.2	0.7	0.1	0.8	1.3	3.9	0.1	1.0
Workload											
(Average number of patients per week per facility) Radiographed	143.2	15.4	6.2	17.9	37.1	4.3	31.4	133.3	120.9	4.4	47.4
(Average number of patients per week per facility) Fluroscoped	18.8	5.6	3.3	5.0	8.0	4.2	3.8	12.0	18.0	3.0	11.3
Equipment											
(Average number per facility) X-ray machines	2.0	1.1	1.0	1.0	1.0	1.0	1.1	1.2	3.0	1.0	1.36
(Average number per facility) X-ray tubes	3.5	1.2	1.0	1.1	1.1	1.1	1.4	1.7	4.4	1.0	1.66
Ratio of tubes to machines	1.70	1.14	1.05	1.12	1.02	1.11	1.29	1.36	1.48	1.00	1.22

*Total includes 1023 facilities that cannot be classified specifically in any of the above categories.

TABLE 2. FACILITY CARD INFORMATION (DARKROOM PROCEDURES) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Facility card information / Darkroom procedures	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinics	Hospitals	Chiropractors	Total*
Number of facilities	146	280	65	1508	122	134	200	141	740	904	5263
Lighttightness of darkroom											
No darkroom	2.7	28.2	38.5	16.1	9.0	9.0	8.0	19.2	8.5	16.5	16.0
Lighttight (Percent)	73.3	45.4	36.9	60.9	71.3	74.6	69.5	64.5	75.4	61.5	61.5
Not Lighttight	4.1	10.0	3.1	11.6	11.5	9.0	13.5	9.9	9.0	9.7	10.4
Undetermined	19.9	16.4	21.5	11.3	8.2	7.5	9.0	6.4	7.0	12.3	12.1
Automatic processing used											
Yes	24.6	0.7	--	0.2	3.3	--	0.5	2.8	14.2	0.4	3.5
No (Percent)	56.8	68.6	78.5	85.8	86.9	95.5	92.5	80.1	77.4	79.1	78.9
Undetermined	18.5	30.7	21.5	14.0	9.8	4.5	7.0	17.0	8.4	20.5	17.6

*Total includes 1023 facilities that cannot be classified specifically in any of the above categories.

TABLE 3. RADIOGRAPHIC CARD INFORMATION (EQUIPMENT IDENTIFICATION) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Radiographic card information / Equipment identification	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinic	Hospitals	Chiropractors	Total*
Number of X-ray machines with radiographic capability	244	180	31	1393	122	128	204	165	1985	906	6380
Combination (radiographic-fluoroscopic capability) (Percent)											
Yes	78.3	80.0	80.6	64.6	11.5	57.8	77.0	68.5	46.9	10.8	46.4
No	20.9	19.5	19.4	33.2	87.7	42.2	23.0	29.1	52.3	88.6	52.5
Unknown	0.8	0.6	--	2.2	0.8	--	--	2.4	0.9	0.6	1.1
Type of X-ray machine (Percent)											
Fixed radiographic	86.0	90.1	96.8	86.4	92.7	84.4	93.1	84.2	57.2	88.5	77.3
Photofluorographic	3.3	0.6	--	0.1	--	--	1.0	4.2	3.2	0.1	1.7
Mobile	4.5	--	3.2	8.6	4.9	12.5	3.9	4.2	36.8	9.7	17.5
Other and unknown	6.1	9.4	--	4.9	2.5	3.1	2.0	7.3	2.8	1.7	3.6
Maximum kilovolt peak (Percent)											
< 50	--	--	--	0.2	--	0.8	--	--	0.25	0.2	0.4
50 - 74	0.8	1.1	3.2	3.1	1.6	2.3	--	1.2	2.3	3.5	4.4
75 - 99	4.9	20.6	19.4	17.6	13.1	27.3	10.8	6.7	16.8	33.6	18.9
100 - 149	78.3	67.2	58.1	63.2	76.2	60.9	77.4	72.1	59.2	43.2	57.1
150 - 249	11.9	0.6	3.2	1.3	2.5	1.6	3.9	3.0	8.3	1.0	4.1
≥ 250	0.8	--	--	0.2	0.8	--	0.5	--	0.7	0.4	0.4
Unknown	3.3	10.6	16.1	14.4	5.7	7.0	7.4	17.0	12.6	18.1	14.7
Maximum milliamperage (Percent)											
< 50	5.7	12.8	25.8	20.0	10.7	32.0	9.3	2.4	24.3	27.9	24.1
50 - 99	--	6.7	9.7	9.3	1.6	9.4	3.4	3.0	3.2	29.2	8.7
100 - 199	3.3	40.5	41.9	45.1	28.7	43.7	35.3	21.2	8.1	20.6	22.3
200 - 299	31.1	26.1	12.9	13.8	42.6	10.2	28.9	38.2	23.5	4.6	18.4
300 - 399	47.5	7.8	--	4.2	11.5	2.3	17.2	17.6	25.4	0.9	13.3
≥ 400	9.0	1.1	3.2	0.4	1.6	--	1.0	2.4	7.7	0.4	3.1
Unknown	3.3	5.0	6.4	7.2	3.3	2.3	4.9	15.2	7.8	16.2	10.0

* Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.

TABLE 4. RADIOGRAPHIC CARD INFORMATION (FILTRATION) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Radiographic card information / Filtration	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinic	Hospitals	Chiropractors	Total*
Number of X-ray machines with radiographic capability	244	180	31	1393	122	128	204	165	1985	906	6380
Total filtration before survey (mm. of Al. equiv.)											
< 1.5	3.3	25.0	38.7	35.6	18.9	41.4	23.0	24.8	17.3	18.6	23.9
1.5 - 2.4 (Percent)	14.8	27.2	29.0	27.7	25.4	26.6	26.5	21.2	16.1	23.1	22.2
≥ 2.5	76.1	37.8	25.8	32.8	54.1	29.0	45.6	47.2	58.5	54.7	47.8
Unknown	5.7	10.0	6.4	3.8	1.6	3.1	4.9	6.7	8.2	3.5	6.2
Total filtration after survey (mm. of Al. equiv.)											
< 1.5	2.4	13.3	16.1	14.6	11.5	14.8	9.3	7.9	9.8	4.4	10.4
1.5 - 2.4 (Percent)	11.4	17.8	16.1	19.6	16.4	21.1	17.2	11.5	15.0	15.0	16.7
≥ 2.5	77.8	57.8	61.3	58.5	69.7	60.1	66.2	65.4	66.4	75.8	64.7
Unknown	7.4	11.1	6.4	7.2	2.5	3.9	7.4	15.2	8.8	4.7	8.0

* Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.

TABLE 5. RADIOGRAPHIC CARD INFORMATION (EXPOSURE SWITCH, TIMER, AND PROTECTIVE DEVICES) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Radiographic card information Exposure switch, timer and protective devices	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinic	Hospitals	Chiropractors	Total*
Number of X-ray machines with radiographic capability	244	180	31	1393	122	128	204	165	1985	906	6380
Exposure switch location - adequate (Percent)	77.9	82.2	96.8	86.1	91.0	85.9	92.2	85.4	83.9	89.3	85.5
Timer - adequate (Percent)	93.0	96.7	93.6	97.1	96.8	96.8	98.5	97.6	94.4	94.5	95.5
Gonadal shields for patients present (Percent)	65.2	36.7	32.3	33.4	54.1	22.6	40.7	59.4	48.0	26.9	38.2
Operator protection - adequate (Percent)	95.9	83.3	83.9	84.6	93.5	77.3	91.7	93.3	90.8	87.5	87.7
Primary and secondary barriers - adequate (Percent)	92.6	79.4	80.6	84.1	90.2	82.0	89.7	85.4	77.3	89.5	83.4
Diagnostic type tube housing (Percent)	84.0	81.1	80.6	83.5	90.2	92.9	87.2	80.6	85.2	93.0	86.7

The difference between the percentages presented and 100% is accounted for by negative, unknown or undetermined categories.

*Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.

TABLE 6. RADIOGRAPHIC CARD INFORMATION (PROCEDURES AND RELATED FACTORS FOR MAJOR PART OF WORKLOAD) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Radiographic card information Procedures and related factors for major part of workload	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinic	Hospitals	Chiropractors	Total*
Number of X-ray machines with radiographic capability	244	180	31	1393	122	128	204	165	1985	906	6380
Usual type of examination											
Chest (Percent)	76.6	94.4	83.9	82.7	31.2	60.1	91.2	87.3	63.7	8.9	59.0
Extremities (Percent)	2.4	--	6.4	8.0	30.3	6.2	3.9	2.4	5.7	2.4	8.5
Spine (Percent)	2.4	1.1	3.2	0.4	17.2	9.4	0.5	--	0.9	66.1	10.8
Usual kilovolt peak											
50 - 74 (Percent)	49.2	66.1	58.1	67.6	60.7	59.4	69.6	61.8	48.1	50.8	55.3
75 - 99 (Percent)	36.5	19.4	29.0	14.3	23.0	14.1	19.6	24.2	31.3	31.0	24.1
Usual milliampere-seconds											
< 6 (Percent)	11.9	11.1	25.8	10.7	12.3	6.2	12.8	6.1	17.4	2.3	11.4
6 - 25 (Percent)	61.5	76.1	61.3	72.2	50.8	64.1	78.4	77.6	51.9	17.8	53.6
26 - 75 (Percent)	10.7	4.4	3.2	5.3	12.3	3.9	2.5	5.4	11.6	27.5	11.8
Usual film size (inches)											
14 x 17 (Percent)	81.2	94.4	64.5	80.7	47.5	69.5	92.6	88.5	70.8	42.5	67.0
10 x 12 (Percent)	6.2	1.7	19.4	5.1	16.4	2.3	2.4	2.4	10.0	4.6	7.5
8 x 10 (Percent)	0.4	0.6	6.4	6.7	25.4	9.4	1.5	1.2	4.0	31.4	10.7

The difference between the percentages presented and 100% is accounted for by infrequently reported items of information and negative, unknown or undetermined categories.

*Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.

(CONTINUED)

TABLE 6. RADIOGRAPHIC CARD INFORMATION (PROCEDURES AND RELATED FACTORS FOR MAJOR PART OF WORKLOAD) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Radiographic card information Procedures and related factors for major part of workload (continued)	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinics	Hospitals	Chiropractors	Total*
Number of X-ray machines with radiographic capability	244	180	31	1393	122	128	204	165	1985	906	6380
Usual film distance (inches)											
30 - 39	6.2	1.7	12.9	11.4	35.2	21.9	4.9	6.7	17.4	47.2	19.8
40 - 49 (Percent)	9.8	5.0	6.4	3.6	27.0	5.5	1.5	4.2	16.6	20.2	11.1
70 - 79	73.4	87.2	67.7	75.2	30.3	54.7	83.3	83.6	47.1	7.7	50.1
Usual beam type											
Circular	50.0	67.2	87.1	74.2	61.5	66.4	58.8	64.2	47.6	66.6	59.7
Rectangular (Percent)	32.8	22.8	6.4	10.3	22.1	12.5	25.5	21.2	29.9	14.6	20.0
Square	3.7	3.3	--	3.4	4.1	2.3	3.4	1.8	6.7	3.1	4.2
Usual beam size (inches)											
<20	34.4	10.6	16.1	13.7	46.7	17.2	22.6	17.0	37.1	30.4	27.5
20 - 24 (Percent)	23.0	12.8	12.8	14.9	19.7	17.9	12.7	17.0	21.1	19.3	17.7
≥25	25.4	66.1	61.3	53.9	14.0	39.8	48.0	53.3	20.8	20.3	32.0
Collimation											
Proper	30.7	17.8	19.4	22.6	36.9	28.1	23.0	18.8	27.7	48.1	30.2
Improper (Percent)	17.6	66.7	64.5	53.1	22.9	44.6	45.1	46.1	20.7	22.5	32.8
Variable	43.0	8.3	6.4	7.8	28.7	7.8	17.6	19.4	34.7	8.0	18.8
Permanent	--	--	--	0.7	--	--	--	--	0.2	2.9	1.1

The difference between the percentages presented and 100% is accounted for by infrequently reported items of information and negative, unknown or undetermined cagegories.

* Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.

TABLE 7. FLUOROSCOPIC CARD INFORMATION (EQUIPMENT IDENTIFICATION) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Fluoroscopic card information Equipment identification	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinic	Hospitals	Chiropractors	Total*
Number of X-ray machines with fluoroscopic capability	181	214	41	470	5**	34	101	77	845	20	2266
Combination (radiographic-fluoroscopic capability) (Percent)											
Yes	98.3	42.5	19.5	69.8		85.3	92.1	92.2	95.4	85.0	79.4
No	1.1	56.5	80.5	27.4	-	11.8	5.9	6.5	4.1	10.0	19.3
Unknown	0.6	0.9	-	2.8		2.9	2.0	1.3	0.5	5.0	1.2
Type (Percent)											
Vertical	-	64.0	9.8	31.5		23.5	6.9	7.8	2.5	25.0	19.3
Horizontal	3.9	3.3	70.7	7.2	-	20.6	5.9	2.6	3.7	20.0	6.7
Tilting Table	96.1	30.8	19.5	55.3		50.0	83.2	80.5	91.9	50.0	70.9
Unknown	-	1.9	-	6.0		5.9	4.0	9.1	1.9	5.0	3.1
Image intensifying device used (Percent)											
Yes	16.0	1.9	-	1.3		5.9	4.0	5.2	14.1	-	7.9
No	81.2	95.8	97.6	91.3	-	82.3	90.1	83.1	82.6	95.0	87.0
Unknown	2.8	2.3	2.4	7.4		11.8	5.9	11.7	3.3	5.0	5.1

*Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.

**Sample size too small to provide meaningful data.

TABLE 8. FLUOROSCOPIC CARD INFORMATION (FLUOROSCOPIC SCREENS) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Fluoroscopic card information Fluoroscopic screens	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinics	Hospitals	Chiropractors	Total*
Number of X-ray machines with fluoroscopic capability	181	214	41	470	5**	34	101	77	845	20	2266
Fluoroscopic screen ganged to X-ray tube (Percent)											
Yes	98.3	93.5	73.2	86.2	--	76.5	87.1	93.5	96.9	75.0	91.8
No	--	3.3	14.6	3.8	--	14.7	--	2.6	0.7	15.0	3.0
Unknown	1.7	3.3	12.2	10.0	--	8.8	12.9	3.9	2.4	10.0	5.1
Shutter functioning (Percent)											
Properly	94.5	86.0	78.0	76.8	--	61.8	77.2	87.0	91.1	75.0	85.6
Improperly	3.9	9.8	12.2	11.1	--	17.6	6.9	9.1	5.0	5.0	7.5
Fixed	--	0.5	4.9	0.4	--	5.9	--	--	0.6	10.0	0.8
Undetermined	1.7	3.7	4.9	11.7	--	14.7	15.8	3.9	3.3	10.0	6.1
Useful beam limited to screen (Percent)											
Yes	68.5	38.3	46.3	32.1	--	35.3	52.5	59.7	69.8	40.0	52.3
No	28.2	55.6	46.3	53.8	--	41.2	30.7	35.1	26.1	50.0	40.2
Unknown	3.3	6.1	7.3	14.0	--	23.5	16.8	5.2	4.0	10.0	7.5
Number of fluoroscopic cards	66	45	1**	121	2**	3**	26	5**	238	2**	544
Leaded screen (from revised form only) (Percent)											
Satisfactory	87.9	91.0	--	73.5	--	--	46.2	--	86.1	--	81.8
Not satisfactory	3.0	4.4	--	0.8	--	--	--	--	2.5	--	2.0
Not applicable	1.5	--	--	2.5	--	--	3.8	--	2.9	--	2.6
Undetermined	7.6	4.4	--	23.1	--	--	50.0	--	8.4	--	13.6

* Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.
** Sample size too small to provide meaningful data.

TABLE 9. FLUOROSCOPIC CARD INFORMATION (DISTANCE, ROENTGEN OUTPUT AND FLUOROSCOPIC ROOM) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Fluoroscopic card information Distance, roentgen output, and fluoroscopic room	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinics	Hospitals	Chiropractors	Total*
Number of X-ray machines with fluoroscopic capability	181	214	41	470	5**	34	101	77	845	20	2266
Target to panel distance (inches)											
<12	-	7.5	2.4	8.5	-	8.8	2.0	-	0.6	-	3.8
12 - 14	5.5	46.3	48.8	28.3	-	17.6	8.9	14.3	5.7	20.0	19.4
15 - 17	22.1	19.6	24.4	27.9	-	23.5	22.8	24.7	15.4	25.0	20.5
18 - 20 (Percent)	63.0	17.8	12.2	17.9	-	32.4	41.6	46.8	69.1	10.0	39.2
≥21	2.8	0.9	2.4	2.6	-	-	3.0	1.3	3.4	15.0	2.7
Unknown	6.6	7.9	9.8	14.9	-	17.6	21.8	13.0	5.8	30.0	9.9
Percent in compliance with HB 76	93.4	84.6	87.8	76.6	-	73.6	76.2	87.0	93.6	70.0	86.3
Roentgen output at panel surface (R/min)											
< 1	1.1	0.9	-	1.3	-	-	-	1.3	2.2	-	1.5
1.0 - 9.9	89.5	59.4	58.5	60.0	-	32.4	72.3	79.2	84.1	45.0	71.8
10.0 - 14.9	5.5	15.4	17.1	7.7	-	14.7	4.0	10.4	4.1	5.0	7.4
15.0 - 19.9 (Percent)	-	6.5	7.3	4.5	-	5.9	-	2.6	1.4	10.0	3.2
≥ 20.0	1.2	10.3	14.7	8.2	-	8.8	3.0	1.3	1.2	5.0	4.8
Unknown	2.8	7.5	2.4	18.3	-	38.2	20.8	5.2	6.9	35.0	11.4
Percent in compliance with HB 76	90.6	60.3	58.5	61.3	-	32.4	72.3	80.5	86.3	45.0	73.3
Lighttightness of fluoroscopic room											
Lighttight	75.1	65.9	53.7	55.7	-	52.9	64.4	70.1	69.6	30.0	64.5
Not lighttight	12.7	23.8	26.8	23.4	-	29.4	12.9	15.6	19.0	55.0	20.1
Not applicable	2.2	0.5	-	0.2	-	-	-	-	2.6	-	1.3
Unknown	9.9	9.8	19.5	20.6	-	17.6	22.8	14.3	8.8	15.0	14.1

*Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.
**Sample size too small to provide meaningful data.

TABLE 10. FLUOROSCOPIC CARD INFORMATION (FILTRATION) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Fluoroscopic card information Filtration	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinics	Hospitals	Chiropractors	Total*
Number of X-ray machines with fluoroscopic capability	181	214	41	470	5**	34	101	77	845	20	2266
Total filtration before survey (mm. of Al. equiv.)											
< 1.5	2.3	16.4	29.2	24.7	--	23.5	7.0	13.0	4.4	15.0	12.4
1.5 - 2.4 (Percent)	2.8	14.5	24.4	14.4	--	23.5	10.9	5.2	3.3	20.0	9.4
≥ 2.5	52.5	36.4	19.5	33.2	--	38.3	43.6	46.8	49.9	40.0	42.7
Unknown	42.5	32.7	26.8	27.7	--	14.7	38.6	35.1	42.4	25.0	35.5
Percent in compliance with HB 76	52.5	36.4	19.5	33.2	--	38.3	43.6	46.8	49.9	40.0	42.7
Total filtration after survey (mm. of Al. equiv.)											
< 1.5	0.6	12.2	12.2	13.9	--	14.7	3.0	7.8	2.7	5.0	7.2
1.5 - 2.4 (Percent)	2.8	12.2	17.1	10.7	--	23.6	11.8	--	2.8	20.0	7.6
≥ 2.5	51.9	41.1	41.5	45.5	--	41.2	45.6	49.4	51.1	45.0	47.8
Unknown	44.8	34.6	29.3	30.0	--	20.6	39.6	42.9	43.3	30.0	37.6
Percent in compliance with HB 76	51.9	41.1	41.5	45.5	--	41.2	45.6	49.4	51.1	45.0	47.8

*Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.

**Sample size too small to provide meaningful data.

TABLE 11. FLUOROSCOPIC CARD INFORMATION (TIMER INFORMATION) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Fluoroscopic card information Timer information	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinics	Hospitals	Chiropractors	Total*
Number of X-ray machines with fluoroscopic capability	181	214	41	470	5**	34	101	77	845	20	2266
Deadman type of exposure switch											
Yes	97.8	94.4	95.1	88.3	--	85.3	86.1	96.1	97.2	90.0	93.8
No (Percent)	0.6	2.3	--	1.5	--	2.9	1.0	--	0.6	--	1.2
Unknown	1.7	3.3	4.9	10.2	--	11.8	12.9	3.9	2.1	10.0	5.0
Manually reset cumulative timer											
Yes	58.0	21.0	12.2	18.1	--	17.6	25.7	40.3	56.4	5.0	38.0
No (Percent)	39.8	77.6	85.4	73.6	--	73.5	57.4	55.8	41.4	85.0	57.5
Unknown	2.2	1.4	2.4	8.3	--	8.8	16.8	3.9	2.1	10.0	4.5
Cumulative timer terminates exposure											
Yes	56.9	20.1	12.2	16.4	--	20.6	22.8	40.3	56.1	5.0	37.2
No (Percent)	40.3	77.1	82.9	74.5	--	70.6	58.4	55.8	41.6	85.0	57.7
Unknown	2.8	2.8	4.9	9.2	--	8.8	18.8	3.9	2.2	10.0	5.0

*Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.
**Sample size too small to provide meaningful data.

TABLE 12. FLUOROSCOPIC CARD INFORMATION (DARK ADAPTATION) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Fluoroscopic card information Dark adaptation	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinic	Hospitals	Chiropractors	Total*
Number of X-ray machines with fluoroscopic capability	181	214	41	470	5**	34	101	77	845	20	2266
Number of minutes of dark adaptation (Percent)											
< 5	7.7	7.5	14.6	16.6	--	20.6	8.9	1.3	8.3	25.0	10.3
5 - 9	3.3	16.4	43.9	10.4	--	11.8	3.0	10.4	3.6	20.0	8.1
10 - 14	13.8	22.0	14.6	17.2	--	20.6	12.9	13.0	12.4	5.0	15.6
15 - 19	32.0	19.6	2.4	13.6	--	8.8	13.9	32.5	25.3	5.0	20.8
≥ 20	32.6	15.0	--	16.2	--	11.8	34.6	22.1	40.2	15.0	27.2
Unknown	10.5	19.6	24.4	26.0	--	26.5	26.7	20.8	10.2	30.0	18.0
Average minutes per user	17.5	13.7	7.3	12.8	--	11.1	17.7	16.8	18.1	10.1	15.8

*Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.
**Sample size too small to provide meaningful data.

TABLE 13. FLUOROSCOPIC CARD INFORMATION (ACCESSORY SHIELDING) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Fluoroscopic card information Accessory shielding	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinic	Hospitals	Chiropractors	Total*
Number of X-ray machines with fluoroscopic capability	181	214	41	470	5**	34	101	77	845	20	2266
Leaded gloves											
Yes	97.8	90.2	95.1	83.4	--	70.6	85.2	94.8	98.4	70.0	92.2
No (Percent)	1.7	7.9	4.9	11.3	--	20.6	3.0	2.6	1.0	20.0	5.2
Unknown	0.6	1.9	--	5.3	--	8.8	11.9	2.6	0.6	10.0	2.6
Leaded apron											
Yes	98.3	91.6	82.9	83.8	--	76.5	85.2	92.2	98.3	70.0	91.9
No (Percent)	1.1	7.0	17.1	12.1	--	14.7	3.0	6.5	1.1	20.0	5.8
Unknown	0.6	1.4	--	4.0	--	8.8	11.9	1.3	0.6	10.0	2.2
Bucky slot cover											
Yes	52.5	12.1	2.4	9.8	--	8.8	29.7	18.2	58.4	10.0	34.0
No (Percent)	45.9	40.2	48.8	62.8	--	73.5	52.5	74.0	37.9	65.0	48.6
Not applicable	--	45.3	48.8	22.3	--	11.8	5.0	5.2	2.5	15.0	14.4
Unknown	1.7	2.3	--	5.1	--	5.9	12.9	2.6	1.2	10.0	3.0
Leaded drapes around screen											
Yes	39.2	6.1	2.4	6.4	--	8.8	16.8	15.6	35.1	10.0	21.3
No (Percent)	60.2	63.1	56.1	78.1	--	79.4	71.3	79.2	60.3	80.0	67.1
Not applicable	--	28.5	41.5	11.3	--	5.9	--	2.6	2.4	--	7.9
Unknown	0.6	2.3	--	4.3	--	5.9	11.9	2.6	2.1	10.0	3.6

*Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.
**Sample size too small to provide meaningful data.

TABLE 14. FLUOROSCOPIC CARD INFORMATION (UPPER GASTROINTESTINAL EXAMINATION) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Fluoroscopic card information Upper gastrointestinal examination (from revised form)	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinics	Hospitals	Chiropractors	Total*
Number of X-ray machines with fluoroscopic capability	66	45	1**	121	2**	3**	26	5**	238	2**	544
Kilovolt peak											
Not performed	--	26.6	--	26.4	--	--	3.8	--	2.5	--	12.3
< 50	--	--	--	0.8	--	--	--	--	--	--	0.2
50 - 74	10.6	11.1	--	14.9	--	--	7.7	--	6.7	--	9.4
75 - 99 (Percent)	66.7	22.2	--	15.7	--	--	23.1	--	57.5	--	42.6
100 - 149	6.1	--	--	0.8	--	--	--	--	8.8	--	4.8
≥ 150	--	2.2	--	--	--	--	--	--	0.8	--	0.6
Unknown	16.7	37.7	--	41.3	--	--	65.4	--	23.5	--	30.1
Minutes tube activated per exam.											
Not performed	--	26.6	--	26.4	--	--	3.8	--	2.5	--	12.3
1	6.1	11.1	--	12.4	--	--	--	--	2.1	--	6.1
2	22.7	17.8	--	4.1	--	--	11.5	--	19.7	--	15.1
3 (Percent)	18.2	4.4	--	8.3	--	--	19.2	--	26.0	--	17.1
4	12.1	2.2	--	3.3	--	--	--	--	10.1	--	7.7
5	22.7	2.2	--	3.3	--	--	3.8	--	11.8	--	9.4
≥ 6	1.5	--	--	--	--	--	--	--	1.7	--	1.1
Unknown	16.7	35.5	--	42.1	--	--	61.5	--	26.0	--	31.2
Average number of minutes	3.3	2.1	--	2.4	--	--	2.9	--	3.2	--	3.1
Number of examinations per week											
Not performed	--	26.6	--	29.8	--	--	7.7	--	3.4	--	12.3
< 5	12.1	28.9	--	24.8	--	--	34.6	--	26.0		23.5
5 - 9	24.2	6.7	--	1.6	--	--	--	--	13.0	--	10.3
10 - 14 (Percent)	22.7	--	--	1.6	--	--	--	--	10.9	--	8.4
15 - 19	9.1	--	--	--	--	--	--	--	6.7	--	4.4
20 - 29	10.6	--	--	0.8	--	--	--	--	8.4	--	5.3
≥ 30	4.5	2.2	--	0.8	--	--	--	--	6.7	--	4.3
Unknown	16.7	35.5	--	40.5	--	--	57.7	--	24.8	--	31.4
Average number of examinations	12.3	5.2	--	5.1	--	--	2.0	--	13.0	--	11.5

*Total includes information from 35 facilities that cannot be classified specifically in any of the above categories.
**Sample size too small to provide meaningful data.

TABLE 15. FLUOROSCOPIC CARD INFORMATION (LOWER GASTROINTESTINAL EXAMINATION) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Fluoroscopic card information Lower gastrointestinal examination (from revised form)	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinics	Hospitals	Chiropractors	Total*
Number of X-ray machines with fluoroscopic capability	66	45	1**	121	2**	3**	26	5**	238	2**	544
Kilovolt peak											
Not performed	1.5	31.1	--	32.2	--	--	3.8	--	3.8	--	15.3
<50	--	--	--	--	--	--	--	--	--	--	--
50 - 74	12.1	6.7	--	10.7	--	--	7.7	--	7.1	--	8.3
75 - 99 (Percent)	65.2	13.3	--	8.3	--	--	23.1	--	56.3	--	38.6
100 - 149	3.0	--	--	--	--	--	--	--	8.4	--	4.0
≥150	--	--	--	--	--	--	--	--	--	--	--
Unknown	18.2	48.8	--	48.8	--	--	65.4	--	24.4	--	33.8
Minutes tube activated per examination											
Not performed	1.5	31.1	--	32.2	--	--	3.8	--	3.8	--	15.3
1	9.1	4.4	--	4.1	--	--	--	--	5.5	--	5.2
2	31.8	11.1	--	3.3	--	--	11.5	--	21.4	--	16.2
3	21.2	2.2	--	5.8	--	--	19.2	--	25.2	--	16.4
4 (Percent)	6.1	2.2	--	3.3	--	--	--	--	8.8	--	6.4
5	12.1	--	--	2.5	--	--	3.8	--	8.0	--	5.7
≥ 6	--	--	--	--	--	--	--	--	1.2	--	0.6
Unknown	18.2	48.8	--	48.8	--	--	61.5	--	26.0	--	34.4
Average number of minutes	2.8	2.1	--	2.8	--	--	2.9	--	3.0	--	2.9
Number of examinations per week											
Not performed	1.5	31.1	--	33.9	--	--	7.7	--	4.2	--	15.3
< 5	28.8	13.3	--	14.9	--	--	34.6	--	31.5	--	24.3
5 - 9	30.3	2.2	--	1.6	--	--	--	--	12.2	--	9.9
10 - 14 (Percent)	7.6	4.4	--	0.8	--	--	--	--	11.3	--	7.0
15 - 19	12.1	--	--	--	--	--	--	--	5.9	--	4.2
20 - 29	3.0	--	--	0.8	--	--	--	--	6.7	--	3.7
≥ 30	--	--	--	--	--	--	--	--	2.9	--	1.5
Unknown	16.7	48.8	--	47.9	--	--	57.7	--	25.2	--	34.2
Average number of examinations	7.8	4.8	--	4.3	--	--	2.0	--	9.5	--	8.4

*Total includes information from 35 facilities that cannot be classified specifically in any of the above categories.
**Sample size too small to provide meaningful data.

TABLE 16. FLUOROSCOPIC CARD INFORMATION (OTHER EXAMINATIONS, AND SPOT FILMS) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Fluoroscopic card information Other examinations and spot films	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private office	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinics	Hospitals	Chiropractors	Total*
Number of X-ray machines with fluoroscopic capability	181	214	41	470	5**	34	101	77	845	20	2266
Number of other examinations per week (Percent)											
None	20.4	14.0	7.3	15.1	-	8.8	10.9	6.5	23.0	10.0	16.6
< 10	16.6	21.9	-	27.2	-	11.8	16.9	19.5	19.7	25.0	21.5
10 - 19	5.0	6.0	-	2.3	-	-	1.0	1.3	6.5	-	4.7
20 - 39	4.4	4.6	-	1.0	-	-	-	6.5	3.4	-	3.0
≥ 40	0.6	-	-	0.8	-	-	-	1.3	1.2	-	0.9
Unknown	53.0	53.3	92.7	53.4	-	79.4	71.3	64.9	46.1	65.0	53.4
Average number per week	11.0	9.0	2.0	6.1	-	2.5	3.9	11.8	10.6	2.0	9.0
Number of spot films per week (Percent)											
None	6.6	69.2	62.4	57.0	-	50.0	24.8	26.0	17.7	75.0	37.4
< 10	5.5	6.1	4.9	9.6	-	-	17.8	5.2	11.0	5.0	8.7
10 - 24	9.9	4.6	-	3.6	-	5.9	9.9	13.0	11.6	-	7.9
25 - 49	14.9	0.9	-	0.4	-	2.9	9.9	18.2	12.5	-	7.6
50 - 99	18.3	0.4	-	1.9	-	-	4.0	11.7	15.0	-	8.5
100 - 199	22.1	0.9	-	0.6	-	-	3.0	5.2	11.6	-	6.7
≥ 200	10.0	-	-	-	-	-	1.0	2.6	5.6	-	3.2
Unknown	12.7	17.8	31.7	26.8	-	41.2	29.7	18.2	14.9	20.0	20.0
Average number per week	111.2	22.5	5.0	21.9	-	20.3	36.1	63.9	81.1	5.0	75.7

*Total includes information from 1023 facilities that cannot be classified specifically in any of the above categories.

**Sample size too small to provide meaningful data.

TABLE 17. FLUOROSCOPIC CARD INFORMATION (TOTAL MILLIAMPERE-MINUTE WORKLOAD) FROM MEDICAL X-RAY PROTECTION SURVEYS FROM 25 STATES AND 2 TERRITORIES AS OF JUNE 30, 1967, BY TYPE OF FACILITY OR TYPE OF PRACTICE

Fluoroscopic card information Total milliampere-minute workload (from revised form)	Type of facility or type of practice										
	Radiologists	Internal medicine	Pediatricians	General practitioners in private offices	Orthopedists	Osteopaths	General practitioners in clinics	Multiple specialty clinics	Hospitals	Chiropractors	Total*
Number of X-ray machines with fluoroscopic capability	66	45	1**	121	2**	3**	26	5**	238	2**	544
Total mA-min/week											
Not performed	1.5	8.9	-	18.2	-	-	7.7	-	6.7	-	8.8
< 50	21.2	55.5	-	44.6	-	-	26.9	-	26.5	-	33.3
50 - 99	13.6	4.4	-	5.0	-	-	7.7	-	12.6	-	9.6
100 - 149 (Percent)	6.1	8.9	-	-	-	-	-	-	10.5	-	6.8
150 - 249	18.2	-	-	0.8	-	-	-	-	12.2	-	8.6
250 - 499	18.2	-	-	-	-	-	-	-	12.6	-	8.1
≥ 500	1.5	-	-	-	-	-	-	-	8.0	-	3.9
Unknown	19.7	22.2	-	31.4	-	-	57.7	-	10.9	-	21.0
Average mA-min/week	174.0	41.1	-	32.7	-	-	36.1	-	197.1	-	144.5

*Total includes information from 35 facilities that cannot be classified specifically in any of the above categories.

**Sample size too small to provide meaningful data.

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KEY WORDS:

X-ray, Survey, Inspection, Frequency Distributions, Facilities, Darkroom, Filtration, Workload

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